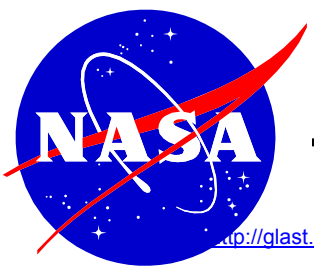
GAMMA-RAY LARGE AREA SPACE TELESCOPE (GLAST) PROJECT

GROUND SYSTEM REQUIREMENTS DOCUMENT

Revision A

December 16, 2003



GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GAMMA-RAY LARGE AREA SPACE TELESCOPE
(GLAST)
PROJECT

GROUND SYSTEM REQUIREMENTS DOCUMENT

REVISION A

DECEMBER 16, 2003

NASA Goddard Space Flight Center

Greenbelt, Maryland

GLAST PROJECT GROUND SYSTEM REQUIREMENTS DOCUMENT

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CH-03	9/10/04	iv, v, 3 and 49	CCR 433-0255 and 433-0261

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Acronyms

APIDs	Application Identifications
ASI	Italian Space Agency
ATS	Absolute Time Sequence
BAPs	Burst Alert Processors
CCSDS	Consultative Committee for Space Data Systems
DAS	Demand Access System
EU	Engineering Unit
FDF	Flight Dynamics Facility
FOT	Flight Operations Team
FSW	Flight Software
GBM	GLAST Burst Monitor
GCN	Gamma ray Coordinates Network
GIOC	GBM Instrument Operations Center
GLAST	Gamma ray Large Area Space Telescope
GN	Ground Network
GPS	Global Positioning System
HEASARC	High Energy Astrophysics Science Archive Research Center
HK	Housekeeping
ICD	Interface Control Document
IOC	Instrument Operations Center
I&T	Integration and Test
IT	Information Technology
Kbps	kilobits per second
KSC	Kennedy Space Center
LAT	Large Area Telescope
L&EO	Launch and Early Orbit
LIOC	LAT Instrument Operation Center
MOC	Mission Operations Center
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NISN	NASA Integrated Services Network
PDB	Project Database
RF	Radio Frequency
RT	Real-time
RTS	Relative Time Sequence
S/C	Spacecraft
SLAC	Stanford Linear Accelerator Center
SN	Space Network
GSSC	GLAST Science Support Center

SSR	Solid State Recorder

SWSI	Space Network Web-based Scheduling Interface
T&C	Telemetry and Command
TDRSS	Tracking and Data Relay Satellite System
ToO	Target of Opportunity
TLE	Two Line Elements
UPS	Uninterruptible Power Supply
USN	Universal Space Network
UTC	Universal Time Coordinated
VC	Virtual Channel
WSC	White Sands Complex

1 Introduction

1.1 Purpose and Scope

This Gamma-ray Large Area Space Telescope (GLAST) Ground System Requirements Document (GSRD) specifies Level-3 requirements for the GLAST Project. These requirements include processing, analyzing, and archiving the data acquired by the Observatory for all phases of the mission. Requirements are specified for facilities, analysis software development, documentation, support services, data delivery, and archiving. The interfaces between the GLAST-wide data analysis system and the particle and astrophysics communities are also specified. These interfaces will allow the science team to access the science data in a timely manner. The requirements in this document are not intended to govern the actions of personnel. The responsibilities of ground system support personnel are detailed in their respective statement of works and operation agreements.

CH-02

1.2 Document Organization

The document organization has the system requirements defined followed by the requirements for each of the elements:

- Ground Communication
- Ground Stations
- Space Network
- Mission Operations Center (MOC)
- Flight Dynamics Facility (FDF)
- Large Area Telescope (LAT) Instrument Operations Center (IOC)
- GLAST Burst Monitor (GBM) IOC
- GLAST Science Support Center (GSSC)
- Gamma-ray Coordinates Network (GCN)
- High Energy Astrophysics Science Archive Research Center (HEASARC)
- Spacecraft Integration and Test (I&T) Facility, and
- Kennedy Space Center (KSC).

The requirement tables in the following section contain columns for the following:

- a unique requirement identification number,
- description,
- comment,
- source,
- and source identification number.

1.3 Requirements Trace Methodology

The purpose of tracing system requirements is to ensure that a requirement is based on an approved parent requirement or set of requirements. The requirements specified in this document are traced to the GLAST Project Mission Systems Specification (MSS) and are derived from the MSS as well as the GLAST Operations Concept Document.

1.4 System Architecture

The GLAST is National Aeronautics and Space Administration's (NASA) next major mission dedicated to observations of high energy gamma rays. The two instruments used to accomplish its scientific goals are the LAT and the GBM. Spectrum Astro, Inc. of Gilbert, Arizona is responsible for the design and manufacture of the GLAST spacecraft (S/C), integration of the two scientific instruments with the S/C, and integration of the complete space vehicle/observatory with the Delta launch vehicle. Spectrum Astro may also be retained for the duration of the GLAST mission to provide routine sustaining engineering support to the Flight Operations Team (FOT) and to maintain the flight software for the S/C. The GLAST observatory is scheduled for launch on a Boeing Delta II 2920H-10 vehicle from the Eastern Test Range, Florida in 2007.

The LAT IOC (LIOC) is located at the Stanford Linear Accelerator Center (SLAC) at Stanford University, California. The LIOC will direct the instrument operations and data processing for the LAT. The GBM IOC (GIOC) is located at Marshall Space Flight Center/National Space Science Technology Center (MSFC/NSSTC) and will direct the GBM instrument operations and data processing. The GSSC runs the guest investigator program, creates and maintains the mission time line from the guest investigator program (after the first year), provides analysis tools to the scientific community, and archives the GLAST data. The GSSC is located at Goddard Space Flight Center (GSFC) and collects inputs from the two IOCs for the creation of the science timeline, which is then sent to the MOC. The GSSC provides data to the general user community and will also interface with the HEASARC. The HEASARC is an archive of astronomy data collected from several extreme ultraviolet, X-ray, and gamma-ray observatories.

The MOC, located at GSFC, is the central point of the ground system architecture. GLAST operations include not only the operation of the S/C and instruments, but also the operation of the ground system itself. The MOC will have interfaces with all areas of the GLAST system shown in Figure 1-1. The MOC will generate the integrated observatory timeline, monitor the health and safety of the observatory, schedule ground station and Tracking and Data Relay Satellite System (TDRSS) contacts, perform level zero processing, and support special engineering activities. GLAST will utilize the Global Positioning System (GPS) of satellites for on-board orbit determination and reference timing. The MOC procedures and software allow automation of telemetry monitoring to optimize MOC staffing during the regular 5-day shifts and to support off-shift periods. GLAST will be supported by 5 to 7 ground contacts per day.

Ground stations such as USN are capable of uplinking commands via S-band received from the MOC and collecting S-banddata downlinked by GLAST. GLAST will also utilize the near continuous coverage provided by the TDRSS space network (SN) for telemetry and commanding as well as special instrument events known as bursts alerts. Burst Alerts are messages generated in response to major gamma ray events and are immediately downlinked to the MOC using TDRSS. These events are then forwarded directly to the GCN for further distribution to the science community. CH-03

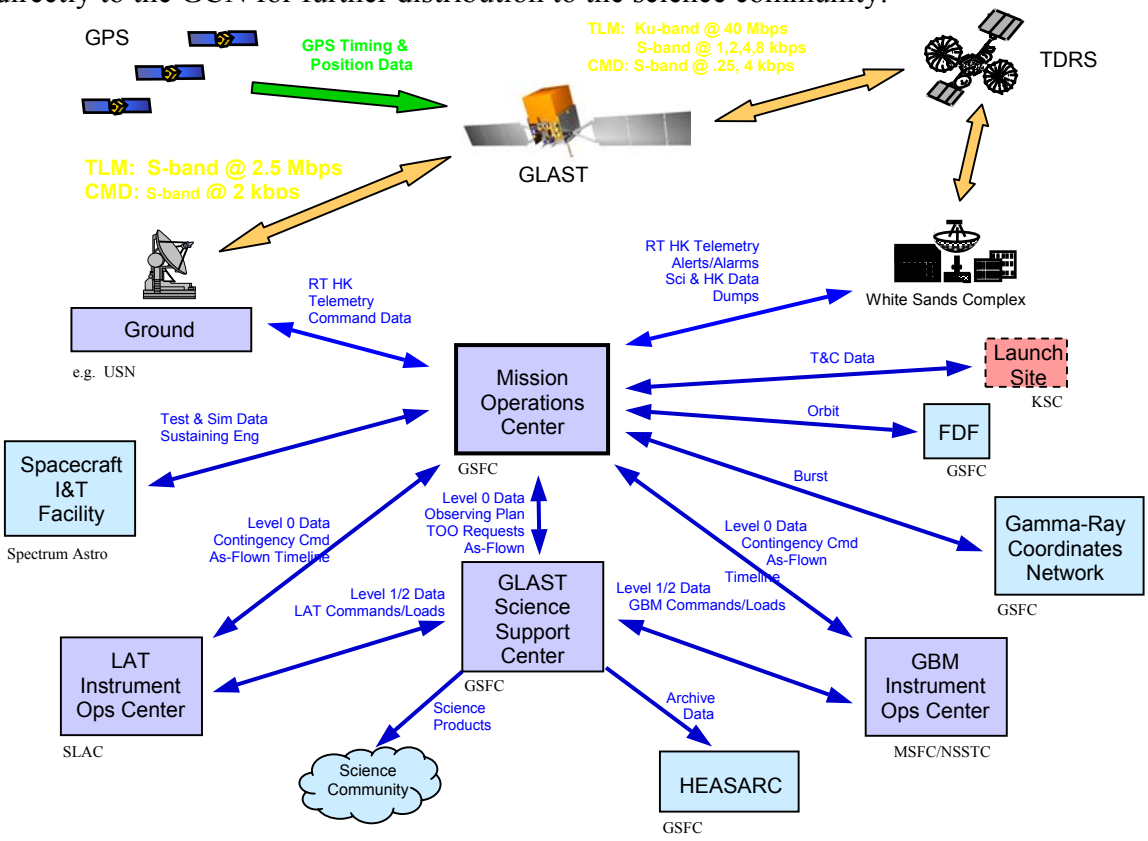

Figure 1-1 GLAST Ground System and Data Interface Diagram

1.5 Definitions

The following definitions provide the meanings for the terms as they are used in this document.

Observatory – The GLAST S/C including the LAT and GBM instruments.

Observatory data – Science, housekeeping, diagnostic, and alert telemetry from the observatory (i.e., any data the observatory transmits to the ground)

Project Database (PDB) – The database the FOT will maintain for the ITOS ground system that will be derived from the observatory Telemetry and Command (T&C)

database delivered by the spacecraft vendor and other ancillary data required for flight operations.

PDB Verification – Includes syntax level checking of the database content and format.

PDB Validation – Process of validating that the execution of the PDB commands leads to the expected results.

Telemetry Decommutation – To extract from the telemetry stream the housekeeping (HK) parameters which then are subjected to the appropriate database conversion.

Launch Critical – Ground System function category where the function is required to conduct in-orbit checkout and safely operate the observatory, and is thus a prerequisite for launch.

Instrument Memory Loads - Instrument bit level loads that are sent directly to the instrument and are not acted upon by the spacecraft other than as a pass through (e.g. flight software (FSW) patches and table loads).

GCN Notice - Burst Alert formatted for distribution by the GCN to the user community.

Ground System – Includes Space Network, ground stations, MOC, LAT IOC, GBM IOC, FDF, GSSC, GCN, and HEASARC.

1.6 Launch Critical Functions

T he Ground System will be designed to meet all requirements in this GSRD. However, in order to facilitate the prioritization of the requirements implementation and testing, the criticality of the associated functions must be defined. The highest priority ground system functions are those required for launch support. These are the functions necessary for conducting in-orbit checkout and safely operating the observatory. The criticality of the GSRD requirements will be determined based on their support of these functions. This will be done in the Requirements Verification Matrix as part of the Ground System Test Program.

The launch critical functions for GLAST are listed below as the ability to:

- Provide ground station S-band and SN Ku and S-band communications with the observatory.
- Acquire, receive, and archive observatory HK and science data.
- Process and display observatory HK telemetry data.
- Recognize, identify, and log observatory alarm conditions.
- Perform observatory engineering analysis.
- Generate and uplink real-time commands by using command scripts.

- Generate and uplink stored command loads.
- Generate and uplink observatory memory loads.
- Initiate and process observatory memory dumps.
- Dump and manage recorded observatory HK and science data.
- Perform Level-0 processing on observatory HK and science data.
- Provide FDF orbit determination using the launch vehicle separation vector.

For clarification the launch critical functions do NOT include the ability to:

- Provide SN Demand Access Services.
- Process and handle Burst Alerts and Targets of Opportunities (ToOs).
- Perform science observation planning (must be done manually).
- Perform Level-1 and above science data processing.

2 Applicable and Reference Documents

2.1 Applicable Documents

The following documents contain requirements that are invoked by this Ground System Requirements Document:

433-SRD-0001, GLAST Science Requirements Document

433-SPEC-0001, GLAST Project Mission System Specification

433-MAR-0004, GLAST Ground Data System Mission Assurance Requirements

CCSDS 101.0-B-5: "Recommendation for Space Data Systems Standards. Telemetry Channel Coding," Blue Book, Issue 5, June 2001

CCSDS 102.0-B-5: "Recommendation for Space Data Systems Standards Packet Telemetry," Blue Book, Issue 5, November 2000

CCSDS 103.0-B-2: "Recommendation for Space Data Systems Standards Packet Telemetry Service Specification," Blue Book, Issue 2, June 2001

CCSDS 201.0-B-3: "Recommendation for Space Data Systems Standards Telecommand Part 1 -- Channel Service," Blue Book, Issue 3, June 2000

CCSDS 202.0-B-3: "Recommendation for Space Data Systems Standards Telecommand Part 2 -- Data Routing Service," Blue Book, Issue 3, June 2001

CCSDS 202.1-B-2: "Recommendation for Space Data Systems Standards Telecommand Part 2.1 -- Command Operation Procedures," Blue Book, Issue 2, June 2001

CCSDS 203.0-B-2: "Recommendation for Space Data Systems Standards Telecommand Part 3 -- Data Management Service," Blue Book, Issue 2, June 2001

CCDS 701.0-B-3: "Recommendation for Space Data Systems Standards Advanced Orbiting Systems, Networks and Data Links: Architectural Specification," Blue Book, Issue 3, June 2001

NPD 8010.2C, NASA Policy Directive, Use of the Metric System of Measurement in NASA Programs, July 2000

NPD 2810.1, NASA Policy Directive, Security of Information Technology, October 1998

NPD 2820.1, NASA Policy Directive, NASA Software Policies, May 1998

Recommendation ITU-R SA.1157: Protection Criteria for Deep-Space Research (1995)

2.2 Reference Documents

The following documents are for reference only.

433-OPS-0001, GLAST Operations Concept Document

Large Area Telescope-GLAST Burst Monitor Burst Telecommand & Alert Telemetry Interface Control Document, 433, ICD-0001

GLAST 1553 Bus Protocol Document, 1196 EI-S46310-000

GLAST Project Large Area Telescope (LAT) Instrument - Spacecraft Interface Requirements Document, 433-IRD-0001

Large Area Telescope (LAT) to Spacecraft Interface Control Document -1196 EI-Y46311-000A

GLAST Project GLAST Burst Monitor (GBM) Instrument - Spacecraft Interface Requirements Document, 433-IRD-0002

GLAST Burst Monitor (GBM) to Spacecraft (SC) Interface Control Document, 1196-EI-Y46312-000A

DAS to DAS Customers ICD (453-ICD-DAS/Customer)

ICD Between the NCC Data System and MOCs (451-ICD-NCCDS/MOC)

3 Requirements

3.1 System Requirements

The System requirements are those requirements that apply to multiple ground system elements (i.e. – a minimum of 3 elements). They establish the base set of requirements that the ground system is required to support.

Req ID	Requirement	Comments	Source	Source ID
General				
SYS0010	The ground system shall observe the current NASA policy directive, NPD 8010.2C, Use of the Metric System of Measurement in NASA programs.		MSS	3.5.1.12
SYS0020	The ground system shall process observatory telemetry that is compliant with the CCSDS Packet Telemetry Recommendations as defined in the Series 100 Blue Books.		MSS	3.1.2.5.1.1 3.5.2.4.1 3.1.4.3.1.2
SYS0030	The ground system shall implement observatory commanding that is compliant with the CCSDS Telecommand recommendations as defined in the Series 200 Blue Books.		MSS	3.1.4.3.1.2
SYS0040	The ground system shall use Universal Time Coordinated (UTC) time as the time base for all operations activities.		MSS	3.3.1.12
SYS0050	The ground system shall plan and schedule science observations for the observatory.	This capability will be used by operations to plan observations.	MSS	3.5.2.3
SYS0060	The ground system shall generate and send commands to the observatory.		MSS	3.5.2.2 3.5.2.3

Req ID	Requirement	Comments	Source	Source ID
SYS0070	The ground system shall process and receive all non-science data received from the observatory.		MSS	3.5.2.2 3.5.2.3 3.5.2.4
SYS0080	The ground system shall provide RF communications for the transmission of commands and telemetry to/from the observatory via the Ground Network (GN) and the Space Network (SN).		MSS	3.1.1.5.1
SYS0090	The ground system shall provide the ground communications network for the exchange of mission data among the ground system elements.		MSS	3.5.1.11
SYS0100	The ground system shall perform health and safety monitoring of the observatory.		MSS	3.5.2.2
SYS0110	The ground system shall process and archive all science data received from the observatory.		MSS	3.5.2.4
SYS0120	The ground system shall provide the tools and interfaces necessary to support sustaining engineering of the observatory for the life of the mission.	Including FSW maintenance, loads, special commanding, data analysis and trending	MSS	3.5.2.2
SYS0130	The ground system shall relay burst alerts to the science community via the Gamma-ray Coordinates Network (GCN) within 6 seconds for at least 80% of all burst alerts.	This is the current allocation to the ground system from the end-to-end 7 second requirement stated in the MSS.	MSS	3.5.2.8 3.1.4.1.2 3.1.4.1.3
SYS0140	The ground system shall support a single higher level science analysis software environment for use by the science community and instrument teams.	This is applicable to the GSSC and IOCs.	MSS	3.5.1.4

Req ID	Requirement	Comments	Source	Source ID
SYS0150	The ground system science analysis shall adhere to standards that ensure software portability, independence of vendor and compatibility with existing multi-mission high energy astrophysics tools.	This is applicable to the GSSC and IOCs. This requirement ensures that the software tools are usable and accessible by a large community that may not specialize in GLAST analysis.	MSS	3.5.1.5
SYS0160	The ground system shall execute a ToO order within 6 hours of approval of a ToO request from the Project Scientist.	This includes the time starting from the Project Scientist approving the request to ending when the commands hit the S/C.	MSS	3.5.2.7.2
SYS0170	The ground system shall support the observatory in-orbit checkout period.	This includes all elements of the ground system. The in-orbit checkout period is expected to be 60 days.	MSS	3.5.1.7
SYS0180	The ground system shall meet all requirements with the observatory at any orbit altitude between 575km and 450 km.	This for example requires RF to work at this altitude range.	MSS	3.5.1.9.4
SYS0190	The ground system shall use the J2000 inertial coordinate system.		MSS	3.5.1.10
SYS0200	The ground system shall use RA and DEC as the standard means of receiving and communicating pointing directions.	This applies to ground station pointing and pointed observations,	MSS	3.5.1.10.2
SYS0210	The ground system shall have the command capability to reorient the observatory to within the pointing envelope of the sky survey mode for downlink transmissions of science data.		MSS	3.5.2.1.1
SYS0220	The ground system shall command the observatory to pointed observation mode in order to acquire observation data on known celestial sources.		MSS	3.5.2.1.2

Req ID	Requirement	Comments	Source	Source ID
SYS0230	The ground system shall maintain the SAA boundary definitions on-board the observatory and on the ground for the instruments and observatory during the course of the mission.	The S/C will use the SAA entry and exit definitions and will notify the instruments accordingly. The MOC will maintain the on-board SAA map used by the S/C.	MSS	3.5.2.2.3
Security				
SYS0500	The ground system shall comply with Information Technology (IT) security requirements specified in NPG 2810.1.		MSS	3.5.1.2
Reliability & Availability				
SYS1000	The ground system shall operate the observatory 24hours/day 365+ days/year.	Availability shall be supported by autonomous operation or personnel where applicable.		Derived
SYS1010	The ground system shall use communication links that provide error-free data transmission and delivery.		MSS	3.5.1.11
SYS1020	The ground system shall implement all approved ToOs that satisfy observatory constraints.			Derived
SYS1030	The ground system shall implement all approved ToOs within the allocated latency.			Derived
SYS1040	The ground system's contribution to Spacecraft Data Loss shall be less than 1.9%.	The ground system allocation begins once the data leaves the S/C.	MSS	3.5.2.4.4
SYS1050	The ground system shall provide a reliability of 99.98% for launch critical functions.	Launch critical functions are defined in Section 1.6.		Derived
Data Processing				

Req ID	Requirement	Comments	Source	Source ID	
SYS2000	The ground system shall retrieve and process the science instrument data into LAT science and GBM trigger data products within 72 hours 95% of the time.	The time starts when the data is stored in the on-board SSR and ends once the Level 1 data products have been generated at the LAT ISOC and the GBM trigger files are generated at GIOC.	MSS	3.1.4.4	CH-02
SYS2005	The ground system shall process the observatory data into GBM 24-hour level-1 science data products (excluding trigger data) within 96 hours 95% of the time.	The time starts when the data is stored in the on-board SSR and ends once the 24-hour level-1 data product has been generated at the GBM IOC.	Derived; MSS	3.1.4.4	CH-02
SYS2010	The ground system shall be able to capture and process a dump of at least 30 hours of recorded science and 36 hours of recorded housekeeping data.	This ensures the Ground System can handle a minimum of 30 hours of science and 36 hours of housekeeping dump data from the observatory and still meet the latency requirements. The data is assumed to be continuously collected at orbit averaged rates.	MSS	3.5.2.4.2	CH-01
SYS2020	The ground system shall process data with an orbit average generation rate of 1.2 Mbps for LAT, 25.5 kbps for GBM, and 51 kbps observatory housekeeping data.		MSS	3.1.1.5.1.3	CH-01
Integration & Test					
SYS3000	The ground system shall provide the unique capabilities to support pre-launch testing.	Example is providing a link between the MOC and Spacecraft I&T Facility to support interface and operations testing.	MSS	3.5.1.6 derived	
Real-time Operations					
SYS5000	The ground system shall ensure that the MOC is the sole interface between the ground system elements and the space-ground communications links.		MSS	3.5.3.1.1	

Req ID	Requirement	Comments	Source	Source ID
Anomaly Response				
SYS9000	The ground system shall ensure that no single point of failure exists for launch critical functions.	The launch critical functions are defined in Section 1.6.	MSS	3.3.1.5 derived from observatory requirement

3.2 Ground Communication Requirements

The ground communication requirements are those requirements that include the data (including the internet) and voice networks between each of the individual elements.

Req ID	Requirement	Comments	Source	Source ID
General				
GCOM0010	The ground communications network shall transmit voice and data among all elements of the ground system.			Derived
Voice Communications				
GCOM0050	During the pre-launch, launch, and early orbit phases, the ground communications network shall provide secure dedicated Closed Circuit Loop (CCL) or Station Conferencing and Monitoring Assembly (SCAMA) voice communications between the MOC and: Ground Stations WSC FDF* GSSC*^^ GCN*^^ LAT IOC^^ GBM IOC^^ Spacecraft I&T Facility KSC	This defines the required access to the Goddard Voice Distribution System (VDS) for SCAMA and CCL support. *= located at GSFC ^^ = Black Phone Black phones can be patched into the voice communications network.		Derived

Req ID	Requirement	Comments	Source	Source ID
GCOM0060	During the normal operations phases, the ground communications network shall provide secure dedicated CCL or SCAMA voice communications between the MOC and: Ground Stations WSC FDF* GSSC*^^ GCN*^^ LAT IOC^^ GBM IOC^^	This defines the required access to the Goddard Voice Distribution System (VDS) for SCAMA and CCL support. * = located at GSFC ^^ = Black Phone Black phones can be patched into the voice communications network.		Derived
Reliability & Availability				
GCOM1000	The ground communications network shall ensure that all circuits supporting real-time operations have the capability to fail-over within 1 minute.			Derived
GCOM1010	The ground communications network shall support all scheduled activities required by the MOC.			Derived
Data Processing				
GCOM2000	The ground communications network shall provide the bandwidth required to transfer 10 hours of recorded observatory data (science and HK) within 4 hours from the SN to the MOC.			Derived
GCOM2010	The ground communications network shall transmit observatory data from the MOC to the IOCs and GSSC within 3 hours (TBD).	The requirement for getting data from the ground stations to the MOC is covered in the GN requirements.		Derived MSS Latency Trace

Req ID	Requirement	Comments	Source	Source ID
Integration & Test				
GCOM3000	The ground communications network shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.		Derived
Real-time Operations				
GCOM5000	The GCOM shall transmit real-time data within 1 second between the MOC and the SN.	Time begins when first bit of the CADU hits the network and ends when the transmission of that bit reaches the MOC.		Derived
GCOM5010	The GCOM shall transmit real-time data within 1 second between the MOC and the ground station.	Time begins when first bit of the CADU hits the network and ends when the transmission of that bit reaches the MOC.		Derived
Automation				
GCOM7000	The ground communications network shall be capable of operating with an unattended MOC.			Derived
Alerts				
GCOM8000	The ground communications network shall transmit burst alerts from the SN to the MOC within .5 seconds for at least 80% of the burst alerts.	The Ground System's ability to meet the burst alert latency requirements is TBR.		Derived
GCOM8010	The ground communications network shall transmit burst alerts from the ground stations to the MOC within .5 seconds for at least 80% of the burst alerts.	The Ground System's ability to meet the burst alert latency requirements is TBR.		Derived
Anomaly Response				
GCOM9000	The ground communications network shall support troubleshooting and resolution of voice and data anomalies.			Derived

3.3 Ground Station Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
GN0010	The ground stations shall provide telemetry and command RF communications interface between the GLAST observatory and the MOC.			Derived
GN0040	The ground station shall accept observatory data with data randomization, convolutional encoding, RS encoding and balanced QPSK interleaving across the I&Q channels.			Derived
GN0050	The ground station shall remove all artifacts of the space to ground transmission such as encoding and randomization.		MSS	3.5.3.1.1
Security				
GN0500	The ground station shall accept commands, schedule requests, and acquisition data only from the MOC.		MSS	3.5.1.2
GN0510	The communications between the Ground Station and the MOC shall only be accessible to authorized users.		MSS	3.5.1.2
Reliability & Availability				
GN1000	The ground station network shall be available at minimum 99.98% of the time.			Derived
GN1010	The ground station shall coordinate interface fault isolation and recovery with the MOC whenever required.		MSS	3.4.3.1.2.2

Req ID	Requirement	Comments	Source	Source ID
Interfaces				
GN1500	The ground station shall transmit and receive products with/from the MOC as defined in the Ground Station/MOC ICD.	This would include products such as: Station status messages, orbit data, schedules, and telemetry and command		Derived
GN1510	The ground station shall exchange telemetry and command data with the GLAST Observatory as specified in the Observatory to Ground ICD.	The ground stations will receive NRZ-M and transmit NRZ-L.		Derived
Data Processing				
GN2000	The ground station shall be required to capture downlinked S-band data sent from the GLAST Observatory.		MSS	3.4.3.3.2
GN2010	The ground station shall be able to send 24 hours of observatory housekeeping data to the MOC within 5 hours of receipt.	This is for contingency support.		Derived
GN2020	The ground station shall archive all data from the GLAST Observatory for a minimum of 7 days, for possible retransmission to the MOC.		MSS	3.4.3.3.6, 3.4.3.3.7
GN2050	The ground station shall initiate the retransmission of data to the MOC within 1 hour of receiving the retransmission request from the MOC.		MSS	3.4.3.3.7
GN2060	The ground station shall store telemetry data from each VC in a separate file.			Derived
GN2070	The ground station shall selectively transmit the stored VC files to the MOC.			Derived

Req ID	Requirement	Comments	Source	Source ID
GN2080	The ground station shall provide real-time station status data to the MOC, including antenna angles, received signal strength, and any other station equipment status required by the MOC.			Derived
Integration & Test				
GN3000	The ground stations shall provide the personnel and facilities to support interface and system test activities.	This includes planning, performing and assessing the tests.		Derived
GN3010	The ground stations shall perform RF interface testing with the S/C at the spacecraft I&T facility.	This would be supported via an RF suitcase unit or the CTV.		Derived
Mission Planning				
GN4000	The ground station shall implement all required site resource planning and scheduling functions.			Derived
GN4010	The ground stations shall schedule a total of at least three (3) real-time contact passes per day for contingency S-band support.	These passes may be distributed among two or more sites.		Derived
GN4020	The ground stations shall accept schedule requests for specific contact times from the MOC for the purpose of scheduling ground contacts.			Derived
GN4030	The ground stations shall provide long-range predictions of planned site usage by other missions for GLAST mission planning purposes.	The MOC will use this is informational purposes only and is not intended for the MOC to do conflict resolution.		Derived
GN4040	The ground stations shall resolve station resource conflicts with other missions.			Derived

Req ID	Requirement	Comments	Source	Source ID
GN4050	The ground station shall provide a schedule of supports for the upcoming two weeks, each week.	Two weeks is dependent on ATS load time scale. This number should be double the duration of a typical ATS load.		Derived
GN4060	The ground station shall accept the updated orbit data from the MOC to perform station scheduling.	Used for station scheduling and S/C tracking.		Derived
GN4070	The ground station shall be able to propagate the observatory orbit using data provided by the MOC to perform station scheduling and tracking.	Used for S/C acquisition and tracking during a contact.		Derived
Real-time Operations				
GN5000	The ground station shall provide the following services to/from the S/C simultaneously: 1) S-band Real-time Telemetry; 2) S-Band Playback Telemetry; 3) S-band Command.		MSS	3.4.3.3.2
GN5010	The ground station shall uplink commands and data to the observatory received from the MOC.		MSS	3.4.3.3.2
GN5020	The ground station shall throughput the command data received from the MOC in real-time, without buffering, filtering, reformatting, processing or staging.			Derived
GN5030	The ground station shall perform virtual channel synchronization and error correction, using the CCSDS AOS standards.		MSS	3.1.4.3.2

Req ID	Requirement	Comments	Source	Source ID
GN5040	The ground station shall forward command data received from the MOC to the S/C within 1 second.	Time begins when the first bit of a command is received by the station from the MOC and ends when that bit leaves the ground station antenna. This does not include network transmission time.		Derived
GN5050	The ground station shall send real-time data to the MOC in real-time, without buffering, filtering, reformatting, processing, or staging.	The specific parameters will be in the Ground Station/MOC ICD.		Derived
GN5060	The ground station shall provide real-time data quality statistics to the MOC including frame counts, missing VCDUs uncorrectable VCDUs, and any other data statistics required by the MOC.	The specific parameters will be in the Ground Station/MOC ICD.		Derived
GN5070	The ground station shall sort and process the observatory data by VC.			Derived
GN5080	The ground system shall forward telemetry frames from real-time VCs to the MOC within 1 second.	Time begins when the first bit of the CADU hits the antenna and ends when the transmission of that bit to the MOC begins. This does not include network transmission time.		Derived
GN5090	The ground station shall provide real-time telemetry and command services while simultaneously flowing playback telemetry from a prior pass or from the station archive to the MOC.	This requirement ensures that the ground station can operate in real-time while forwarding stored data from a previous contact.		Derived
GN5100	The ground station shall process an aggregate real-time VC rate (up to 4 VC's) of at least 200 kbps.			Derived

Req ID	Requirement	Comments	Source	Source ID
GN5110	The ground station shall receive S-band downlink data at a rate of 2.5 Mbps.		MSS	3.4.3.3.2
GN5120	The ground station shall provide an S-band command uplink data rate of 2 kbps.	Support for lower rates may be required.	MSS	3.4.3.3.2
Automation				
GN7000	The ground station shall operate with an unattended MOC.	This includes planning and scheduling, pre-pass, real-time, post-pass, and routine analysis support to the MOC.	MSS	3.4.3.2
Alerts				
GN8000	The ground station shall process real-time burst alerts at any time during a contact.		MSS	3.5.2.8, 3.4.2.2.1
GN8010	The ground station shall initiate the transmission of burst alerts to the MOC within 5 seconds of receipt of the signal from the observatory 95% of the time.	This is derived by combining the 5 second allocation for TDRSS and the 0.5 second allocation for the SN/MOC data link.	MSS	3.1.4.1
Anomaly Response				
GN9000	The ground station shall support troubleshooting and resolution of voice and data anomalies.			Derived
GN9010	The ground station network shall schedule a station within 15 minutes if the station will be in view of the S/C in the event that the MOC declares a S/C emergency.			Derived

3.4 Space Network Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
SN0010	The SN shall provide telemetry and command RF communications interface between the GLAST observatory and the MOC.			Derived
SN0020	The SN shall provide at least 65 minutes of contact time (Ku-band return/S-band forward) per day.	This is based on a 1.36 Mbps average on-board data generation rate (1.2 Mbps for LAT) and a 40 Mbps dump rate. It also provides the necessary operations margin.		Derived
SN0030	The SN shall nominally provide contacts (Ku-band return/S-band forward) that are spaced evenly, with the time between contacts varying by no more than 2 hours.			Derived
SN0040	The SN shall accept observatory data with data randomization, convolutional encoding, RS encoding and balanced QPSK interleaving across the I&Q channels.			Derived
SN0050	The SN shall remove all artifacts of the space to ground transmission such as encoding and randomization.	This is intended to be implemented by the Ku-band front end processor (FEP).		Derived
Security				
SN0500	The SN shall accept commands, schedule requests, acquisition data, or other GLAST-related control data only from the MOC.		MSS	3.5.3.1.1
SN0510	The communications between the SN and the MOC shall only be accessible by authorized users.		MSS	3.5.1.2

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Req ID	Requirement	Comments	Source	Source ID
Reliability & Availability				
SN1000	The SN shall support all approved ToOs.			Derived
SN1010	The SN shall provide Demand Access S-band service on a 24x7 basis.			Derived
SN1020	The SN shall deliver at least 99.98% of the data it receives to the MOC.	This includes S-band and Ku-band data.		Derived
SN1030	The SN shall contribute a data loss of no more than 0.9%.	The total allocation for the ground system is 1.9%.	MSS	3.5.2.4.4
Interfaces				
SN1500	The scheduled SN services shall transmit and receive products with/from the MOC as defined in the SN/MOC ICD.	This would include products such as: Station status messages, orbit data, schedules, and telemetry and command s. The SN will receive NRZ-M and transmit NRZ-L.		Derived
SN1510	The scheduled SN services shall exchange telemetry and command data with the GLAST Observatory as specified in the Observatory to SN ICD.			Derived
SN1520	The SN DAS shall transmit telemetry to the MOC.			Derived
SN1530	The SN DAS shall receive telemetry from the GLAST Observatory.	DAS service will be provided for ToO execution, auto-repoint, and S/C anomalies.		Derived
SN1540	The SN shall provide DOWD data to the FDF (TBR).	DOWD is the Differenced One-Way Doppler approach to orbit determination.		Derived
Data Processing				
SN2000	The SN shall record all downlinked S-band data sent from the GLAST Observatory.			Derived
SN2010	The SN shall record all downlinked Ku-band data sent from the GLAST Observatory.	This is intended to be implemented by the Ku-band front end processor (FEP).		Derived

Req ID	Requirement	Comments	Source	Source ID
SN2020	The SN shall archive all S-band data from the GLAST Observatory for a minimum of 50 hours.	This is for possible retransmission to the MOC.		Derived
SN2030	The SN shall nominally initiate transfers of recorded Ku-band dump data within 1 hour of the completion of each contact.	The transfer rate over the network link is specified in the GCOM section.		Derived
SN2040	The SN shall be able to send 10 hours of observatory HK data to the MOC within 5 hours of receipt.	This is for contingency support.		Derived
SN2050	The SN shall initiate the retransmission of data to the MOC within 1 hour of receiving the retransmission request from the MOC.			Derived
SN2060	The SN shall store data by VCID for selective retransmission.	This is intended to be implemented by the Ku-band FEP.		Derived
SN2070	The SN shall perform virtual channel synchronization and error correction, using the CCSDS AOS standards for S-band data.			Derived
SN2080	The SN shall perform virtual channel synchronization and error correction, using the CCSDS AOS standards for Ku-band data.	This is intended to be implemented by the Ku-band FEP.		Derived
Integration & Test				
SN3000	The SN shall provide the personnel and facilities to support pre-launch interface and system test activities	This includes planning, performing and assessing the tests.		Derived
Mission Planning				
SN4000	The SN shall provide the ability for the MOC to request SN services.	This is currently performed via SWSI.		Derived

Req ID	Requirement	Comments	Source	Source ID
SN4010	The SN shall be able to schedule two separate TDRS S/C to support GLAST simultaneously for the purpose of obtaining Differenced-One-Way Doppler ranging data.	The ability for the spacecraft to support DOWD is TBR.		Derived
SN4020	The SN shall accept schedule requests for specific times from the MOC.			Derived
SN4030	The SN shall provide TDRSS schedule data to the MOC.			Derived
SN4040	The SN shall provide the DAS TDRS handover schedule to the MOC.	This will be implemented by SWSI.		Derived
SN4050	The SN shall electronically notify the MOC of any pending changes to the DAS/TDRSS schedule at least 12 hours prior to the change.	This must be a message sent to the MOC system that can be read by software.		Derived
SN4060	The SN shall accept GLAST orbit vector updates from the MOC.	IIRVs This will be implemented by SWSI.		Derived
SN4070	The SN shall provide the near-term prediction TDRSS availability to the MOC for GLAST mission planning purposes.	This refers to the TDRS unscheduled Time (TUT).		Derived
SN4080	The SN shall provide a schedule of supports for the upcoming two weeks, each week.	Two weeks is dependent on ATS load time scale. This number should be double the duration of a typical ATS load.		Derived
SN4090	The SN shall provide a TDRSS forward and return link service within 30 minutes of receiving the request from the MOC for high priority commanding.	This includes S/C anomalies.		Derived
SN4100	The SN shall provide a forward and return link service for the execution of a ToO within 30 minutes of a request from the MOC.			Derived

Req ID	Requirement	Comments	Source	Source ID
Real-time Operations				
SN5010	The SN shall uplink commands and data to the observatory from the MOC.		MSS	3.4.2.3
SN5020	The SN shall throughput the command data received from the MOC in real-time, without buffering, filtering, reformatting, processing or staging.			Derived
GN5030	The SN shall forward telemetry frames from real-time VCs to the MOC within 1 second.	Time begins when the first bit of the CADU hits the antenna and ends when the transmission of that bit to the MOC begins. This does not include network transmission time.		Derived
SN5040	The SN shall forward command data received from the MOC to the S/C within 1 second.	Time begins when the first bit of the command is received by the station from the MOC and ends when that bit leaves the TDRSS antenna. This does not include network transmission time.		Derived
SN5050	The SN shall send real-time data to the MOC in real-time, without buffering, filtering, reformatting, processing, or staging.	The specific parameters will be in the SN/MOC ICD.		Derived
SN5070	The SN shall forward S-band telemetry frames from real-time VCs to the MOC within 1 second.	Time begins when first bit of the CADU hits the TDRSS antenna and ends when the transmission of that bit to the MOC begins. This does not include network transmission time.		Derived

Req ID	Requirement	Comments	Source	Source ID
SN5075	The SN shall forward Ku-band telemetry frames from real-time VCs to the MOC within 1 second.	Time begins when first bit of the CADU hits the TDRSS antenna and ends when the transmission of that bit to the MOC begins. This does not include network transmission time.		Derived
SN5080	The scheduled SN service shall provide real-time data quality statistics to the MOC.	The specific parameters will be in the SN/MOC ICD. These parameters should include frame counts, missing VCDUs, uncorrectable VCDUs, and any other data statistics required by the MOC.		Derived
SN5090	The SN shall provide real-time station status data to the MOC, including antenna angles, received signal strength, and any other station equipment status required by the MOC.	ODMs		Derived
SN5100	The SN shall provide station operational data messages to the MOC whenever the TDRS link is active.			Derived
SN5110	The SN shall provide command and telemetry communications for on-orbit operations.			Derived
SN5120	The SN shall provide an Ku-band return link service at a rate 40 Mbps.		MSS	3.4.2.3
SN5130	The SN shall provide an S-band Single Access return link service at rates 1, 2, 4, and 8 kbps.	Support for lower rates (e.g., 4, 2, 1, 0.500, 0.250 kbps) may be required.	MSS	3.4.2.3
SN5140	The SN shall provide an S-band Multiple Access return link service at rates of 1 and 2 kbps.	Support for lower rates (e.g., 1, 0.500, 0.250 kbps) may be required.	MSS	3.4.2.3
SN5150	The SN shall provide an S-band Single Access forward link service at a rate of 4 kbps.		MSS	3.1.1.5.1.2

Req ID	Requirement	Comments	Source	Source ID
SN5160	The SN shall provide an S-band Multiple Access forward link service at a rate of 250 bps.		MSS	3.1.1.5.1.2
SN5170	The SN shall provide a Ku-band Multiple Access return link service at a rate of 40 Mbps.		MSS	3.4.3.3.2
Automation				
SN7000	The SN shall operate with an unattended MOC.	This includes planning and scheduling, pre-pass, real-time, post-pass, and routine analysis support to the MOC.		Derived
Alerts				
SN8000	The SN shall forward alert telemetry to the MOC received on the DAS and Ku-band return link service.	Alert telemetry will either be on the DAS or Ku-band service and not simultaneously on both.	MSS	3.5.2.8
SN8010	The SN shall begin transmitting the burst data to the MOC from WSC within 5 seconds of receipt of the signal from the observatory for at least 80% of all burst alerts.	This is the time to get from the spacecraft transponder to initiate transmission to the MOC from WSC. The ability for the SN to support this 5 second latency given the current S/C design is TBR.	MSS	3.1.4.1

3.5 Mission Operations Center Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
MOC0010	The MOC shall perform mission planning & scheduling, command generation, real-time (R/T) command and telemetry processing, mission monitoring and analysis, data processing, and automated pass execution functions for command & control and health & safety monitoring of the GLAST S/C.		MSS	3.5.1.8
MOC0020	The MOC shall be the sole interface for commands between the elements of the ground system and the space-ground communications links.		MSS	3.5.3.1.1
MOC0030	The MOC shall support a single 8-hour by 5-day shift (M-F) approach and shall operate autonomously whenever not staffed.	Operate here means receive and transmit telemetry and send pages if problems are encountered. Commands are not sent automatically.	MSS	3.5.1.3 & 3.5.1.8 derived
MOC0040	The MOC shall allow authorized remote users to access system functions for viewing RT and historical data.		MSS	3.5.1.2 3.5.3.5 derived
MOC0050	The MOC shall provide a web interface to authorized users for access to MOC data products.		MSS	3.5.3.5 3.5.1.2 derived

Req ID	Requirement	Comments	Source	Source ID
MOC0060	The MOC shall process observatory telemetry that is compliant with the Consultative Committee for Space Data Systems (CCSDS) Packet Telemetry Recommendations as defined in the Series 100 Blue Books.	Telemetry will be compliant with AOS Version 2.	MSS	3.5.2.4.3.1
MOC0070	The MOC shall implement observatory commanding that is compliant with the CCSDS Telecommand recommendations as defined in the Series 200 Blue Books.	Commanding will follow COP-1 protocol.	MSS	3.4.1.5 derived
MOC0080	The MOC shall utilize the COP-1 protocol to verify correct receipt of commands on the S/C.		MSS	3.4.1.5 derived
MOC0090	The MOC shall maintain SAA boundary definitions relative to the S/C during the course of the mission.	The S/C will use the SAA entry and exit definitions and will notify the instruments accordingly. The MOC will maintain the on-board SAA map used by the S/C.	MSS	3.5.2.2.3
Documentation				
MOC0200	The MOC shall maintain electronic documentation of operating procedures to specify the tasks to be performed for routine operational and contingency activities.			Derived
MOC0210	The MOC shall maintain configuration control of the electronic documentation.			Derived
MOC0220	The MOC shall restrict access to the electronic documentation to authorized operations personnel.		MSS	3.5.1.2
Facility				
MOC0250	The MOC facility shall restrict physical access to allow entry to authorized personnel only.		MSS	3.5.1.2 derived

Req ID	Requirement	Comments	Source	Source ID
MOC0260	The MOC facility shall provide console, analysis and meeting space for the FOT, S/C engineers and the instrument team engineers during Launch and Early Orbit (L&EO).			Derived
MOC0270	The MOC facility shall provide a voice communications system with the capability to connect to ground stations, Kennedy Space Center (KSC) launch site, the SN, the IOCs, the FDF, the Spacecraft I&T Facility, and the GSSC.	This can be a combination of dedicated (e.g., SCAMA) circuits and commercially-provided circuits (i.e., Black phone)	MSS	3.5.1.8 & 3.5.1.11
MOC0280	The MOC facility shall provide UTC clock and countdown clock displays.		MSS	3.3.1.12 derived
MOC0290	The MOC facility shall provide a master time signal for the MOC systems.	e.g. NASA 36	MSS	3.3.1.12 derived
MOC0300	The MOC facility shall provide an uninterruptible power supply (UPS) to all the MOC systems.	This is to provide the opportunity to gracefully shutdown non-critical functions and allow backup power to be supplied.		Derived
MOC0310	The MOC facility shall access a backup power capability in the event of a utility power outage.	Current plans are to access diesel power in building 14.		Derived
MOC0320	The MOC facility shall provide black/white and color printers to generate reports, printouts, and plots as required.			Derived
MOC0330	The MOC facility shall support R/T operations, mission planning, data processing, mission analysis and special operations (e.g. L&EO).		MSS	3.5.1.8 derived
MOC0340	The MOC facility shall provide the physical resources to host the GIOC-provided BAP.	These resources include space, power, cooling, network access, etc.		Derived

Req ID	Requirement	Comments	Source	Source ID
Database				
MOC0400	The MOC shall ingest and verify the observatory telemetry & command (T&C) database provided by the S/C vendor.	Verification includes syntax level checking of database, Ex. Command mnemonic created expected bit sequence.		Derived
MOC0410	The MOC shall construct the ground segment database to define any ground commands or parameters to be processed by the MOC.	Ground parameters are items such as ground station statistics and ground commands are those needed to control the MOC system.		Derived
MOC0420	The MOC shall construct a Project Database (PDB) that consists of the observatory T&C database and the ground segment database.			Derived
MOC0430	The MOC shall accept database updates from the IOCs and incorporate them into the PDB.	This applies to post-launch since the Observatory Data Base is no longer being provided by the S/C vendor.		Derived
MOC0440	The MOC shall maintain configuration control of the PDB, command PROCs, display page definitions and configuration monitor definitions.			Derived
Security				
MOC0500	The MOC shall restrict computer access to authorized personnel		MSS	3.5.1.2 derived
MOC0510	The MOC shall monitor the MOC network and log all network security violations.		MSS	3.5.1.2 derived
Reliability & Availability				
MOC1000	The MOC shall support mission operations 24-hours per day, 7 days per week		MSS	3.5.1.8 derived
MOC1010	The MOC shall contribute a data loss of no more than 1%.	The total allocation for the ground system is 1.9%.	MSS	3.5.2.4.4

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Req ID	Requirement	Comments	Source	Source ID
MOC1020	The MOC shall be maintained for the entire mission lifetime with no loss in MOC capability or performance.			Derived
Interfaces				
MOC1500	The MOC shall interface with the ground station network for planning and conducting S/C contacts.		MSS	3.1.1.5.3, 3.5.3.1.1 & 3.5.3.1.2
MOC1510	The MOC shall interface with the SN for planning and conducting S/C contacts.		MSS	3.5.3.1.1 & 3.5.3.1.2
MOC1520	The MOC shall interface with the GSSC for the exchange of mission planning and data products.		MSS	3.5.1.2 & 3.5.1.3 derived
MOC1530	The MOC shall receive requests for retransmission of observatory data from the IOCs.			Derived
MOC1540	The MOC shall submit requests for retransmission of observatory data to the ground stations.		MSS	3.4.3.3.7
MOC1550	The MOC shall interface with the GBM IOC for the exchange of mission planning and data products.	The primary mission planning path is through the GSSC.	MSS	3.5.1.2 & 3.5.1.3 derived
MOC1560	The MOC shall interface with the LAT IOC for the exchange of mission planning and data products.	The primary mission planning path is through the GSSC.	MSS	3.5.1.2 & 3.5.1.3 derived
MOC1570	The MOC shall interface with the S/C vendor facility for support of sustaining engineering functions.	This for example covers the receipt of FSW updates.	MSS	3.5.2.2

Req ID	Requirement	Comments	Source	Source ID
MOC1580	The MOC shall exchange telemetry and command data with the GLAST S/C as specified in the GLAST *Spacecraft-MOC ICD*.		MSS	3.5.3.1.2 derived
MOC1590	The MOC shall interface with the FDF for the exchange of orbit and attitude determination-related data.		MSS	3.5.3.2
Data Processing				
MOC2000	The MOC shall perform Level 0 processing using observatory data files received from the ground stations and TDRSS.		MSS	3.5.1.3 derived
MOC2010	The MOC shall generate Level 0 files for each contact that contain error free, time ordered non-duplicate series of packets.	Each file may have one or multiple application identifications (APIDs). MOC will not merge dump files from multiple contacts meaning that there may be duplicate data across files.	MSS	3.5.1.3 derived
MOC2020	The MOC shall automatically monitor the delivery of telemetry data from the SN and alert the operations staff when the data is not received in the required time.		MSS	3.5.1.3 derived
MOC2030	The MOC shall automatically assess the quality of each file received from the SN and page appropriate personnel if problems are detected that require operator intervention.		MSS	3.5.1.3 derived
MOC2040	The MOC shall maintain a record of the quality and completeness of the telemetry for the duration of the mission.		MSS	3.5.2.11 derived
MOC2050	The MOC shall distinguish between test data and operational data.	Dependent upon having appropriate flags set in the data.		Derived

Req ID	Requirement	Comments	Source	Source ID
MOC2060	The MOC shall generate meta-data for each Level 0 file that describes the characteristics of the file.		MSS	3.5.1.3 derived
MOC2070	The MOC shall generate the Level 0 data files and initiate transmission to the SSC and the IOCs within 4 hours of receiving the dump files from the ground station.	Applies only if no problems are encountered that require operator intervention. Otherwise the data will be delivered on a best effort basis.	MSS	3.1.4.4.2 derived
MOC2080	The MOC shall retrieve and process archived observatory data.		MSS	3.5.2.11 derived
MOC2090	The MOC shall copy products to removable physical media.			Derived
MOC2100	The MOC shall archive the Level 0 data files a minimum of seven days.	This provides the capability to retransmit the files to the GSSC or IOCs as necessary.	MSS	3.5.2.11 derived
MOC2110	The MOC shall transmit real-time housekeeping data to the LIOC and shall be able to enable and disable this link.	This is intended to be configurable in the MOC so that the real-time link to the LIOC is brought up only when needed.	MSS	3.5.1.3 derived
MOC2120	The MOC shall transmit recorded Level 0 data to the GIOC and LIOC.		MSS	3.5.1.3 derived
MOC2130	The MOC shall process delayed data within 24 hours of its arrival.	This is data resulting from a retransmission request sent by the MOC.		Derived
Integration & Test				
MOC3000	The MOC shall provide the personnel and facilities to support pre-launch interface and system test activities.	This means that the personnel and system resources are provided as needed for the test activities.	MSS	3.5.1.6 derived
MOC3010	The MOC shall ingest telemetry and command databases directly from the IOCs for test support.		MSS	3.5.1.6 derived

Req ID	Requirement	Comments	Source	Source ID
Mission Planning				
MOC4000	The MOC shall schedule all activities for the GLAST observatory except those autonomously executed by the S/C.	The primary mission planning tasks are: A. Integrated Observatory Timeline Generation. B. Ground Station Scheduling. C. TDRSS Scheduling. D. ATS and RTS Load Creation and Management.	MSS	3.5.2.2 derived
MOC4010	The MOC shall schedule all S/C and instrument engineering events within the constraints of the S/C and instruments.	This applies to non-science related activities needed for observatory HK.	MSS	3.5.2.2 derived
MOC4020	The MOC shall schedule all contacts with the S/C for command uplink and telemetry downlink.	This applies to the SN/TDRSS and ground stations.	MSS	3.5.3.1.1 & 3.5.3.1.2 derived
MOC4030	The MOC shall receive electronic notification from the SN of any pending changes to the DAS/TDRSS schedule at least 12 hours prior to the change.	This message must be in a format that can be read by software.		Derived
MOC4040	The MOC shall accept flight software load requests from the S/C vendor facility and the IOCs including the FSW load and time/conditions to uplink.		MSS	3.5.2.2.2 derived
MOC4050	The MOC shall provide TDRSS ephemeris information to the S/C.	This provides information to communicate with TDRSS.	MSS	3.5.2.2 derived
MOC4060	The MOC shall manage the Solid State Recorder (SSR) to include dumping and re-dumping of science and engineering data.		MSS	3.5.2.2 derived

Req ID	Requirement	Comments	Source	Source ID
MOC4070	The MOC shall maintain a record of all instrument loads and commands received from the GSSC or IOCs.			Derived
MOC4080	The MOC shall recreate the FSW memory image in the event the on-board image is corrupted.	Applies to spacecraft and instrument FSW. Ensures that the MOC can recreate a flight memory image if there is an on-board CPU reboot.		Derived
Integrated Observatory Timeline				
MOC4200	The MOC shall generate an Integrated Observatory Timeline.	The Integrated Observatory Timeline is based on inputs from the GSSC, ground stations, the SN, and flight operations. It contains a list of planned activities/events.		Derived
MOC4210	The MOC shall use UTC time for planning and generation of commands.		MSS	3.3.1.8 derived
MOC4220	The MOC shall produce ATS loads that correlate with the Integrated Observatory Timeline.			Derived
MOC4230	The MOC shall ingest and integrate the science timelines created by the GSSC.	These timelines are sequences of onboard activities.	MSS	3.5.2.3 derived
MOC4240	The MOC shall provide the Integrated Observatory Timeline to the GSSC and IOCs.			Derived
MOC4250	The MOC shall provide the As-Flown Observatory Timeline to the GSSC and the IOCs.			Derived
MOC4260	The MOC shall update the on-board ATS command load based on late schedule change requests.	Here the users (IOCs, GSSC, and MOC) have determined that the planned observations already loaded on the S/C need to be changed.		Derived

Req ID	Requirement	Comments	Source	Source ID
MOC4270	The MOC shall ingest and integrate the ground station contact schedules.		MSS	3.5.3.1.1 derived
MOC4280	The MOC shall ingest and integrate the TDRSS contact schedules.		MSS	3.5.3.1.1 derived
MOC4290	The MOC shall generate and manage command constraint definitions.			Derived
MOC4300	The MOC shall verify all command loads against constraints prior to uplink to the S/C.			Derived
Target Of Opportunity (ToO)				
MOC4400	The MOC shall accept Target of Opportunity (ToO) observation orders from the GSSC.		MSS	3.5.2.7.2 derived
MOC4410	The MOC shall provide an automatic acknowledgement of the receipt of a ToO order to the GSSC within 10 minutes.		MSS	3.5.2.7.2 derived
MOC4420	The MOC shall send the GSSC a message that specifies the disposition of the ToO order.		MSS	3.5.2.7.2 derived
MOC4430	The MOC system shall generate ToO commands, schedule TDRSS forward link service, and transmit the commands within 4 hours of receipt of the ToO order from the GSSC.	Does not include the time required by the GSSC for ToO handling. It does include the time to make the SN forward link service available, which means the MOC must give the SN at least 30 minutes to provide the service (see associated SN TOO requirement). Latency applies only if no problems are encountered that require operator intervention. Otherwise the ToO will be handled on a best effort basis.	MSS	3.5.2.7.2
MOC4440	The MOC shall maintain a log for the duration of the mission of all ToO orders and their dispositions.		MSS	3.5.2.11 derived

Req ID	Requirement	Comments	Source	Source ID
Autonomous Repoint (AR) Support				
MOC4500	The MOC shall maintain a log for the duration of the mission of all ARs that execute, their dispositions, and their status.		MSS	3.3.2.4.1 Derived
MOC4510	The MOC shall notify appropriate science and operations personnel in the event of an AR			Derived
Flight Dynamics				
MOC4600	The MOC shall generate orbital products using S/C provided orbit information and NORAD provided Two Line Elements (TLE).		MSS	3.5.3.2
MOC4610	The MOC shall provide orbit and attitude-related telemetry data to the FDF.	MOC expected to provide extracted telemetry parameters to the FDF (e.g., sequential print files).	MSS	3.5.3.2
MOC4620	The MOC shall receive and ingest orbit products from the FDF.	Ingest means that the MOC will integrate the FDF orbit products with the mission planning function.	MSS	3.5.3.2
MOC4630	The MOC shall perform orbit propagation.		MSS	3.5.3.2
MOC4640	The MOC shall ensure 1 second accuracy for a minimum of 3 days for Absolute Time Commands.	This drives the accuracy of the orbit propagation function in the MOC, and thus the accuracy of stored command execution times.	MSS	3.5.3.2
MOC4650	The MOC shall deliver orbit data products to the GSSC and the IOCs.	This includes predictive and/or definitive data. The specific products are defined in the Operations Products ICD.	MSS	3.5.3.2
MOC4660	The MOC shall maintain a log of orbit solutions for the duration of the mission.		MSS	3.5.3.2
MOC4670	The MOC shall provide the capability to uplink orbit ephemeris data to the observatory.	This capability is needed if the onboard GPS system is not functioning properly.	MSS	3.5.3.2

Req ID	Requirement	Comments	Source	Source ID
Ground Station Scheduling				
MOC4800	The MOC shall to schedule contacts with ground stations.		MSS	3.5.3.1.1 derived
MOC4810	The MOC shall provide orbital elements to the ground stations for contact acquisition.		MSS	3.5.3.2 derived
TDRSS Scheduling				
MOC4900	The MOC shall schedule the SN services.	This applies to scheduling TDRSS/DAS, WDISC MA, WDISC SSA, and Ku-band services via the Space Network Web Services Interface (SWSI).	MSS	3.5.3.1.1
MOC4910	The MOC shall provide S/C orbit information to the SN for contact acquisition.		MSS	3.5.3.2
Real Time Operations				
Telemetry				
MOC5000	The MOC shall receive, process and monitor telemetry data from the GLAST observatory.		MSS	3.5.1.3
MOC5010	The MOC shall ingest and store all CCSDS transfer frames received.		MSS	3.5.2.11 derived
MOC5020	The MOC shall receive R/T HK telemetry from the ground station at a maximum rate of 51 kbps.		MSS	3.5.3.1.2 derived
MOC5030	The MOC shall receive and process R/T telemetry from TDRSS at a maximum rate of 51 kbps.		MSS	3.5.3.1.2 derived
MOC5040	The MOC shall receive, process, and display status data from ground stations.		MSS	3.1.1.5.3

Req ID	Requirement	Comments	Source	Source ID
MOC5050	The MOC shall receive, process, and display status data from the SN.		MSS	3.3.5.4 Observatory constraint extended to the MOC-derived
MOC5060	The MOC shall receive burst telemetry from the ground stations and SN.		MSS	3.1.4.1.3 & 3.5.3.3 derived
MOC5070	The MOC shall receive recorded observatory HK and science data post pass.	Science data will only come from the SN.	MSS	3.1.1.5.3, 3.1.4.4.2 & 3.5.2.4.3.1
MOC5080	The MOC shall receive and process S/C and instrument on-board processor memory dump and table dump data.	Provided to S/C vendor and the IOCs for further processing.	MSS	3.5.2.4.3.1
MOC5090	The MOC shall receive and process observatory event and telecommand logs.	This will allow the FOT to view interpreted log reports for troubleshooting.	MSS	3.5.2.2 & 3.5.2.2.1
MOC5100	The MOC shall identify questionable quality data based on information received from the ground stations and the SN.		MSS	3.5.2.4.1
MOC5110	The MOC shall provide transfer frame processing statistics on each VC and on the aggregate.	This will include items such as the total number of frames for each of: received, good frames, sequence errors, and Reed-Solomon decoding errors.	MSS	3.5.2.4.1
MOC5120	The MOC shall archive all incoming frame telemetry data for the life of the mission.		MSS	3.5.2.11
MOC5130	The MOC shall extract parameter data from the observatory HK packets, and perform the necessary conversions per the T&C database.	Telemetry processing includes providing data extraction, state conversions and Engineering Unit (EU) conversions.		Derived

Req ID	Requirement	Comments	Source	Source ID
Limits				
MOC5200	The MOC system shall automatically monitor R/T and playback telemetry data for limit violations as defined in the PDB and provide operations notification.	Limit checking will be performed on both analog and discrete telemetry parameters. The MOC system will not perform limit checking on questionable quality data.	MSS	3.5.2.2
TDRSS Messages				
MOC5250	The MOC shall receive unscheduled TDRSS messages containing S/C and instrument alert telemetry through the SN/Demand Access System (DAS).		MSS	3.5.3.1.2
MOC5260	The MOC shall receive Burst telemetry from the S/C via the SN/DAS.		MSS	3.5.3.1.2
Display Pages				
MOC5300	The MOC shall display processed telemetry data and their associated quality and status attributes in R/T display pages.			Derived
MOC5310	The MOC shall print telemetry snapshots of any display page.			Derived
MOC5320	The MOC shall display telemetry data plots via screen plots.			Derived
Events				
MOC5350	The MOC shall generate and display time-tagged event messages indicating all command activity, telemetry processing status, limit violations, configuration changes, and all error and warning conditions.			Derived
MOC5360	The MOC shall log all event messages to a history file in the chronological order in which they are generated.		MSS	3.5.2.11

Req ID	Requirement	Comments	Source	Source ID
MOC5370	The MOC shall retrieve and display logged system event messages.		MSS	3.5.2.11
Command				
MOC5400	The MOC shall send commands to the observatory using ground stations, and the SN/TDRSS.	This includes R/T commands, command loads, software loads and table loads.	MSS	3.5.3.1.1
MOC5410	The MOC shall transmit commands to the ground network (GN) at an effective uplink rate of 2 kbps.		MSS	3.5.3.1.2 derived
MOC5420	The MOC shall transmit commands to the SN/TDRSS at effective uplink rates of 250 bps and 4 kbps.		MSS	3.5.3.1.2 derived
MOC5430	The MOC shall generate R/T commands based on a combination of the definitions in the PDB and user input.			Derived
MOC5440	The MOC shall generate stored command loads, including absolute and relative time sequence loads (ATS and RTS).		MSS	3.3.2.2.7 & 3.3.2.3.10 derived
MOC5450	The MOC shall generate software memory loads for uplink to the S/C from flight software images provided by the S/C and instrument Flight Software (FSW) maintenance facilities.		MSS	3.5.2.2.2
MOC5460	The MOC shall maintain a ground reference image for S/C memory.			Derived
MOC5470	The MOC shall provide protection against the unintentional issue of a critical command, as indicated in the PDB by requiring the operator to explicitly allow the command to be sent.			Derived

Req ID	Requirement	Comments	Source	Source ID
MOC5480	The MOC shall archive all executed commands for the life of the mission.		MSS	3.5.2.11 derived
MOC5490	The MOC shall provide a user interface language for system configuration and control, telemetry monitoring and commanding.			Derived
MOC5500	The MOC shall provide the capability to bypass COP-1 commanding.		MSS	3.4.1.5 derived
Ground System Monitoring				
MOC5600	The MOC shall monitor the MOC systems to determine any network and system process failures affecting processing functions.			Derived
MOC5610	The MOC shall monitor external interfaces required for real-time operations to determine their availability for support.	Will be limited by the availability of status information from the external systems.		3.5.3 derived
Offline Analysis				
MOC6000	The MOC shall monitor the HK telemetry data for S/C and instrument health and safety.		MSS	3.5.2.2 & 3.5.2.2.1 derived
MOC6010	The MOC shall automatically process recorded observatory HK data when received from the ground stations and SN.		MSS	3.5.1.3
MOC6020	The MOC shall create pass summaries that describe the results of each S/C contact.	This includes selected mnemonics, procedures executed, S/C events, system events, commands sent, and limit and configuration monitor violations.		Derived
MOC6030	The MOC shall extract specific parameter data and create a sequential print ASCII formatted file.			Derived

Req ID	Requirement	Comments	Source	Source ID
MOC6040	The MOC shall generate sequential print files from recorded housekeeping data at up to ten times the real-time rate for trend analysis support.	The sequential print files are the collection of telemetry parameters that are used for trend plots, etc.		Derived
MOC6050	The MOC shall replay and process recorded housekeeping data at up to twice the real-time rate.	This provides the ability to replay previously recorded data through the real-time system.		Derived
Configuration Monitoring				
MOC6100	The MOC shall monitor the configuration of the observatory and detect deviations from expected states.		MSS	3.5.2.2 & 3.5.2.2.1 derived
As-flown timeline				
MOC6150	The MOC shall produce an as-flown timeline that reflects the observations that were actually executed on the observatory.	The as-flown timeline will be derived from the observatory housekeeping telemetry. This should reflect ToOs and auto repoints.		Derived
MOC6160	The MOC shall provide the as-flown timeline covering a 24-hour period to the GSSC and the IOCs within 7 days.			Derived
Timeline Monitoring				
MOC6200	The MOC shall generate reports to allow confirmation of command execution to account for any commands that have not executed.	Applies to both stored and real-time command execution.	MSS	3.5.2.2 & 3.5.2.2.1 derived
Trend Analysis				
MOC6250	The MOC shall perform data trending and analysis of observatory HK data.		MSS	3.5.2.2 derived
MOC6260	The MOC shall generate graphic and numeric plots and reports of historical observatory HK data.		MSS	3.5.2.2 derived

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Req ID	Requirement	Comments	Source	Source ID
MOC6270	The MOC shall provide the capability to maintain trends of key parameters for the life of the mission.	Key parameters will be determined by the Flight Operations Team.	MSS	3.5.2.11 derived
MOC6280	The MOC shall perform statistical analysis of selected parameters over selected time-spans.	Ex. Daily maximum, minimum, mean and standard deviation statistics	MSS	3.5.2.2 derived
MOC6290	The MOC shall provide access to trending and analysis capabilities via the Internet for analysis by remote users.		MSS	3.5.3.5 derived
MOC6300	The MOC shall display and print reports, and save them to a file			Derived
MOC6310	The MOC shall provide the capability to export observatory HK data in ASCII format.	Provides ability for external analysis applications to access observatory data (e.g., Excel tool).	MSS	3.5.3.5 derived
Clock correlation				
MOC6400	The MOC shall monitor accuracy and performance of the S/C clock as it compares to UTC.	The ability to support this assumes that sufficient information is available in HK telemetry.	MSS	3.5.3.2 GPS derived
Automation				
MOC7000	The MOC shall automatically detect ground system and S/C anomalies and page on-call personnel when appropriate.		MSS	3.5.1.3 derived
MOC7010	The MOC shall support automated SN and ground station passes.	Applicable to post L&EO phase for nominal operations.	MSS	3.5.1.3 derived
MOC7020	The MOC shall operate autonomously for at least 96 hours without operator intervention.		MSS	3.5.2.2 derived

Req ID	Requirement	Comments	Source	Source ID	
Alerts					
TDRSS Message Monitoring					
MOC8000	The MOC shall monitor burst alerts from TDRSS and initiate a page to appropriate on-call personnel for alerts meeting pre-defined criteria.		MSS	3.1.2.4 derived	
MOC8010	The MOC shall monitor emergency alert messages received from TDRSS and initiate a page to appropriate on-call personnel when the MOC is not staffed.		MSS	3.4.2.2.1 derived	
MOC8020	The MOC shall monitor HK telemetry messages from TDRSS and initiate a page to on-call personnel for any anomalies or limit violations as appropriate.		MSS	3.5.2.2 & 3.5.2.2.1 derived	
Burst Alert Handling					
MOC8100	The MOC shall transmit burst telemetry to GIOC and Burst Alert Processor (BAP) received from ground stations and the SN.		MSS	3.5.3.3 derived	
MOC8110	The MOC shall transmit burst alerts to the BAP within 0.5 seconds of their receipt.	Performance measured from receipt at the MOC to initiation of the transfer.	MSS	3.1.4.1.3	CH-02
MOC8112	The MOC shall transmit burst alerts to the GIOC.	A best effort will be used to achieve a near real-time latency.	MSS	3.1.4.1.3	CH-02
Anomaly Response					
MOC9000	The MOC shall monitor autonomous S/C pass operations and ground systems without the presence of MOC personnel.		MSS	3.5.1.3 derived	

Req ID	Requirement	Comments	Source	Source ID	
MOC9010	The MOC shall automatically log an anomaly report for system-detected events meeting pre-defined criteria.			Derived	
MOC9020	The MOC shall enter and manage S/C and ground system anomaly reports.			Derived	
MOC9030	The MOC shall maintain for the life of the mission the database of all S/C and ground anomalies for both pre-launch and post-launch operations.		MSS	3.5.2.11 derived	
MOC9040	The MOC shall send notifications to FOT personnel within 5 minutes following the detection of an observatory alert message when the MOC is not staffed.		MSS	3.5.1.3 derived	CH-03
MOC9050	The MOC shall maintain a log of all user notifications sent and acknowledgements received.		MSS	3.5.2.11 derived	
MOC9060	The MOC shall perform a manual fail-over to a backup, real-time system within 1 minute of initiation of the manual fail over.	This applies only to MOC systems and not external systems that interface with the MOC.	MSS	3.5.2.4.4 derived	CH-02
MOC9065	The MOC shall send notifications to FOT personnel within 5 minutes following the detection of a failure of a real-time or offline system when the MOC is not staffed.		MSS	3.5.2.4.4 derived	CH-02 CH-03
MOC9070	The MOC shall provide backup capabilities for all MOC systems.		MSS	3.1.4.2.1.3 & 3.5.2.4.4	
MOC9080	The MOC shall perform a manual fail-over to a backup non-real-time system within 30 minutes of initiation of the manual fail over.	This applies only to MOC systems and not external systems that interface with the MOC.	MSS	3.1.4.4 & 3.5.2.4.4	CH-02

Req ID	Requirement	Comments	Source	Source ID
MOC9090	The MOC shall restore backup capabilities after a MOC real-time system failure within 12 hours.		MSS	3.5.2.4.4 derived
MOC9100	The MOC shall backup operational files and recover the system from the backup.		MSS	3.5.1.8 derived
MOC9110	The MOC shall re-plan the Integrated Observatory Timeline within 2 hours.			Derived

3.6 Flight Dynamics Facility Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
FDF0010	The FDF shall provide orbit analysis support to the MOC for the pre-launch, and L&EO phases.	May also be used for contingency support during the operations phase if needed.	MSS	3.5.3.2
FDF0020	The FDF shall validate the on-board computed attitude during the L&EO phase (TBD).	May also be used for contingency support during the operations phase if needed. Performed in the MOC.		Derived
FDF0030	The FDF shall receive GPS and attitude telemetry data from the MOC.	This allows for independent validation of on-board-generated orbit and attitude solutions.	MSS	3.5.3.2
FDF0040	The FDF shall receive the launch vehicle separation vector from KSC during launch.		MSS	3.5.3.2
FDF0050	The FDF shall provide orbit determination support using the launch vehicle separation vector.		MSS	3.5.3.2
FDF0060	The FDF shall perform orbit determination using the MOC provided GPS data.		MSS	3.5.3.2
FDF0070	The FDF shall perform orbit determination using TDRSS Differenced One-Way Doppler (DOWD)data provided by the SN.		MSS	3.5.3.2
FDF0080	The FDF shall perform orbit determination using NORAD Two-Line Elements (TLE).		MSS	3.5.3.2
FDF0090	The FDF shall provide predictive and definitive orbit products to the MOC.		MSS	3.5.3.2

Req ID	Requirement	Comments	Source	Source ID
FDF0100	The FDF shall perform attitude determination using telemetry data provided by the MOC within a pointing accuracy of 1.0 degrees (TBD).	It is expected that this will be performed by an FDF provided system in the MOC instead of the FDF facility.		Derived
FDF0110	The FDF shall provide attitude validation results to the MOC (TBD).	This can be satisfied by using an FDF display in the MOC facility.		Derived

3.7 LAT IOC Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
LIOC0010	The LIOC shall adhere to mission specified data formats and standards.	The standards and formats for transferring data within the ground system will be documented in the Science Data Products ICD.		Derived
LIOC0020	The LIOC shall support an on-orbit operational lifetime of a minimum of 5 years following an initial period of on–orbit checkout.		MSS	3.5.1.8
Reliability & Availability				
LIOC1000	The LIOC shall be maintained for the entire mission lifetime with no loss in LIOC capability or performance.			Derived
Interfaces				
LIOC1500	The LIOC shall interface with the GSSC for the exchange of mission planning and data products.		MSS	3.5.1.2
LIOC1510	The LIOC shall interface with the MOC for the exchange of mission planning and data products.	Mission planning and data products include for example instrument flight software loads and ToOs. The primary interface with the LIOC is the GSSC. The specifics will be defined in the Operations Data Products Document.	MSS	3.5.1.2
LIOC1520	The LIOC shall accept post-pass transmission of LAT and SC housekeeping Level 0 data from the MOC.		MSS	3.5.1.3

Req ID	Requirement	Comments	Source	Source ID
Data Processing				
LIOC2000	The LIOC shall receive LAT science and Observatory HK Level 0 data from the MOC.		MSS	3.5.1.3
LIOC2010	The LIOC shall process LAT instrument data into a common form agreed upon by the LIOC and GSSC.	This will be defined in the Science Data Products ICD.		Derived
LIOC2020	The LIOC shall develop the science analysis tools needed to analyze LAT Level 1 data.	These are the tools used to generate Level 2/3 products. These are provided to the GSSC for use by the general user community.	MSS	3.5.1.4 3.5.1.5
LIOC2030	The LIOC shall develop the LAT Instrument Response Functions (IRFs) necessary for the analysis of Level 1 data.			Derived
LIOC2040	The LIOC shall receive and process Level 0 LAT science event data into level 1 data.			Derived
LIOC2050	The LIOC shall process overlapping Level 0 data delivered from the MOC.	Duplicate packets will be removed during processing. Overlapping packets could exist between individual L0 files meaning that there may be duplicate data across files.		Derived
LIOC2055	The LIOC shall complete the processing of Level 1 data within 24 hours of receipt of Level 0 data.		MSS	3.1.4.4.3
LIOC2060	The LIOC shall provide Level 1 data products to the GSSC.			Derived
LIOC2070	The LIOC shall process delayed data within 24 hours of its arrival without interfering with nominal operations.	This is data resulting from a retransmission request sent to MOC.		Derived

Req ID	Requirement	Comments	Source	Source ID
LIOC2075	The LIOC shall have the capability to process instrument science data with an orbit average data generation rate that is twice the normal rate.		MSS	3.5.2.5
LIOC2080	The LIOC shall archive all Level 0 data for the life of the mission.			Derived
LIOC2085	The LIOC shall use LAT science event data to validate and refine the burst alert information.		MSS	3.5.2.8 3.5.3.3
LIOC2086	The LIOC shall provide the GCN with any improved burst locations.		MSS	3.5.2.8 3.5.3.3
LIOC2090	The LIOC shall convert LAT housekeeping data to engineering units and monitor instrument limits and Configuration states.			Derived
LIOC2100	The LIOC shall develop and maintain the telemetry and command (T&C) databases for LAT operations.			Derived
LIOC2110	The LIOC shall provide a validated LAT T&C database to the MOC.			Derived
LIOC2120	The LIOC shall provide the MOC validated and verified changes to LAT T&C databases.			Derived
Integration & Test				
LIOC3000	The LIOC shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6
Mission Planning				
LIOC4000	The LIOC shall provide the GSSC mission operations planning and coordination for LAT.			Derived

Req ID	Requirement	Comments	Source	Source ID
LIOC4010	The LIOC shall maintain a record of all instrument loads and commands sent to the GSSC or MOC.			Derived
LIOC4020	The LIOC shall coordinate scheduling and planning of LAT operations activities with the GSSC.			Derived
LIOC4030	The LIOC shall nominally schedule the uplink of LAT loads via the GSSC.	Alternate path will be from the LIOC directly to the MOC for test, launch and early orbit and contingency support.		Derived
LIOC4040	The LIOC shall nominally provide LAT instrument loads and commands to the GSSC.	Instrument memory loads are table and fsw updates.		Derived
LIOC4050	The LIOC shall receive, process, and archive orbit data products from the MOC.	The orbit data products could be predictive or definitive products.		Derived
Instrument Commanding				
LIOC4100	The LIOC shall generate instrument memory loads for uplink to the LAT.		MSS	3.5.2.2.2
LIOC4110	The LIOC shall nominally provide LAT instrument loads and commands to the GSSC.		MSS	3.5.2.2.2
LIOC4130	The LIOC shall be capable of providing instrument loads and commands directly to the MOC for uplink to the LAT.	This is for test, L&EO, and contingency support.	MSS	3.5.2.2.2
LAT FSW				
LIOC4200	The LIOC shall generate the load files to implement changes to LAT flight software.		MSS	3.5.2.2.2
LIOC4210	The LIOC shall validate and verify changes to LAT flight software with the LAT testbed prior to release of modified LAT flight software for uplink.			Derived

Req ID	Requirement	Comments	Source	Source ID
LIOC4220	The LIOC shall maintain and operate a LAT FSW testbed.	This is to support functions such as anomaly resolution, command procedure validation, and FSW load validation.		Derived
LIOC4230	The LIOC shall provide configuration control and maintain the integrity of the on-board LAT flight software for the duration of on-orbit mission operations.			Derived
Real-time Operations				
LIOC5000	The LIOC shall monitor, assess, and record the health and safety of the instrument.		MSS	3.5.2.2 3.5.2.2..1
LIOC5010	The LIOC shall receive observatory real-time HK data from the MOC.		MSS	3.5.2.2 3.5.2.2.1
LIOC5020	The LIOC shall provide the capability to process and display real-time LAT and S/C HK data with appropriate indicators for out of limit conditions.		MSS	
Offline Analysis				
LIOC6000	The LIOC shall receive and process to command histories, as-flown timelines, command procedures, observatory ephemerides, Integrated Observatory Timelines, and operations logs developed by the MOC.	Formats are specified in the Operations Data Products ICD.		Derived
LIOC6010	The LIOC shall receive the as-flown timeline covering a 24-hour period from the MOC.			Derived
LIOC6015	The LIOC shall produce, update, and make public the models used for the analysis resulting in the LAT source catalogs.			Derived

Req ID	Requirement	Comments	Source	Source ID
LIOC6020	The LIOC shall submit requests to the MOC for retransmission of observatory data.	If the MOC decides the data needs to be retransmitted from the ground station then the request needs to be received within 4 days.		Derived
Instrument Health and Safety				
LIOC6100	The LIOC shall monitor LAT health and status to verify proper operation of the instrument.	This is using recorded LAT HK data.	MSS	3.5.2.2 3.5.2.2.1
LIOC6110	The LIOC shall maintain an operations log which records operations activities.	This includes all changes to flight and ground system configurations whether directly commanded or initiated autonomously.		Derived
LIOC6120	The LIOC shall perform trend analysis of LAT housekeeping data over the life of the mission.	This is to assist operations personnel in predicting future performance and identifying potential performance issues		Derived
LIOC6130	The LIOC shall archive all Level 0 housekeeping data received, and all trend analyses, operations logs, calibration updates, and LAT diagnostic data developed.			Derived
LIOC6140	The LIOC shall use pre-launch test and calibration data to aid in assessing the performance of the instrument and adjust the instrument tables, engineering calibrations, or software.			Derived
LIOC6150	The LIOC shall maintain knowledge of the LAT configuration as determined from the telemetry, command history and operations logs.			Derived

Automation				
LIOC7000	The LIOC shall accept autonomous data transfers from the MOC.		MSS	3.5.1.3
LIOC7010	The LIOC shall automatically connect to the MOC for the real-time data link.	This ensures that the MOC and LIOC can automatically re-establish the real-time data link.	MSS	3.5.1.3

3.8 GBM IOC Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
GIOC0010	The GIOC shall adhere to mission specified data formats and standards.	The standards and formats for transferring data within the ground system will be documented in the Science Data Products ICD.		Derived
GIOC0020	The GIOC shall support an on-orbit operational lifetime of a minimum of 5 years following an initial period of on–orbit checkout.		MSS	3.5.1.8
Reliability & Availability				
GIOC1000	The GIOC shall be maintained for the entire mission lifetime with no loss in GIOC capability or performance.			Derived
Interfaces				
GIOC1500	The GIOC shall interface with the GSSC for the exchange of mission planning and data products.		MSS	3.5.1.2
GIOC1510	The GIOC shall interface with the MOC for the exchange of mission planning and data products.	Mission planning and data products include for example instrument flight software loads and ToOs. The primary interface with the GIOC is the GSSC. The specifics will be defined in the Operations Data Products Document.	MSS	3.5.1.2
GIOC1520	The GIOC shall interface with the GCN for the exchange of burst alert-related information.		MSS	3.5.3.3

Req ID	Requirement	Comments	Source	Source ID
Data Processing				
GIOC2000	The GIOC shall receive GBM science and Observatory HK Level 0 data from the MOC.		MSS	3.5.1.3
GIOC2010	The GIOC shall process GBM instrument data into a common form agreed upon by the GIOC and GSSC.	This will be defined in the Science Data Products ICD.		Derived
GIOC2020	The GIOC shall develop the science analysis tools needed to analyze GBM Level 1 data.	These are the tools used to generate Level 2/3 products. These are provided to the GSSC for use by the general user community.	MSS	3.5.1.4 3.5.1.5
GIOC2030	The GIOC shall develop the GBM Instrument Response Functions (IRFs) needed for the analysis of Level 1 data.			Derived
GIOC2040	The GIOC shall receive and process Level 0 GBM science event data into level 1 data.			Derived
GIOC2050	The GIOC shall process overlapping Level 0 data delivered from the MOC.	Duplicate packets will be removed during processing. Overlapping packets could exist between individual L0 files meaning that there may be duplicate data across files.		Derived
GIOC2055	The GIOC shall complete the processing of GBM 24-hour Level 1 science data (excluding trigger data) within 24 hours of receipt of the last segment of Level 0 continuous data for that day, 95% of the time.	More or less than 24 hours may elapse between receipt of the first and last segments of Level 0 continuous data by the GIOC, depending upon the phasing of ground contacts with the spacecraft. The worst case latency of GBM Continuous data is 36+12+48 =96 hours, as per SYS2005	MSS	3.1.4.4.3

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Req ID	Requirement	Comments	Source	Source ID
GIOC2056	The GIOC shall complete the processing of Level 1 trigger data within 24 hours of receipt of Level 0 trigger data, 95% of the time.	The time starts when the first segment of Level 0 TTE data has been received at the GIOC. Burst Alert data is not counted, as it is transmitted to the ground through a different channel (TDRSS DAS).	MSS	3.1.4.4.3
GIOC2060	The GIOC shall provide Level 1 data products to the GSSC.			Derived
GIOC2070	The GIOC shall process delayed data within 24 hours of its arrival without interfering with nominal operations.	This is data resulting from a retransmission request sent to the MOC.		Derived
GIOC2075	The GIOC shall have the capability to process instrument science data with an orbit average data generation rate that is twice the normal rate.		MSS	3.5.2.5
GIOC2080	The GIOC shall archive all Level 0 data for the life of the mission.			Derived
GIOC2090	The GIOC shall convert housekeeping data to engineering units and monitor instrument limits and configuration states.			Derived
GIOC2100	The GIOC shall develop and maintain the T&C databases for GBM operations.			Derived
GIOC2110	The GIOC shall validate, verify and maintain configuration control for the commands and command procedures databases.			Derived
GIOC2120	The GIOC shall provide the MOC validated and verified changes to GBM operations databases.			Derived
Integration & Test				

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Req ID	Requirement	Comments	Source	Source ID
GIOC3000	The GIOC shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6
Mission Planning				
GIOC4000	The GIOC shall provide the GSSC mission operations planning and coordination for GBM.			Derived
GIOC4010	The GIOC shall maintain a record of all instrument loads and commands sent to the GSSC or MOC.			Derived
GIOC4020	The GIOC shall coordinate scheduling and planning of GBM operations activities with the GSSC.			Derived
GIOC4030	The GIOC shall nominally schedule the uplink of GBM loads via the GSSC.			Derived
GIOC4040	The GIOC shall nominally provide GBM instrument loads and commands to the GSSC.	Instrument memory loads are table and fsw updates.		Derived
GIOC4050	The GIOC shall receive, process, and archive orbit data products from the MOC.	Orbit data products include definitive and/or predictive data.		Derived
Instrument Commanding				
GIOC4100	The GIOC shall generate instrument memory loads for uplink to the GBM.		MSS	3.5.2.2.2
GIOC4110	The GIOC shall nominally provide GBM instrument loads and commands to the GSSC.		MSS	3.5.2.2.2
GIOC4130	The GIOC shall be capable of providing instrument loads and commands directly to the MOC for uplink to the GBM.	This is for test and L&EO support.	MSS	3.5.2.2.2
GBM FSW				
GIOC4200	The GIOC shall generate the load files to implement changes to GBM flight software.		MSS	3.5.2.2.2

Req ID	Requirement	Comments	Source	Source ID
GIOC4210	The GIOC shall validate and verify changes to GBM flight software with the GBM testbed prior to release of modified GBM flight software for uplink.			Derived
GIOC4220	The GIOC shall maintain and operate a GBM testbed.	This is to support functions such as anomaly resolution, command procedure validation, and FSW load validation.		Derived
GIOC4230	The GIOC shall provide configuration control and maintain the integrity of the on-board GBM flight software for the duration of on-orbit mission operations.			Derived

Req ID	Requirement	Comments	Source	Source ID
Offline Analysis				
GIOC6000	The GIOC shall have access to command histories, as-flown timelines, command procedures, observatory ephemerides, Integrated Observatory Timelines, and operations logs developed by the MOC.	Formats are specified in the Operations Data Products ICD.		Derived
GIOC6010	The GIOC shall receive the as-flown timeline covering a 24-hour period from the MOC.			Derived
GIOC6020	The GIOC shall submit requests to the MOC for retransmission of observatory data.	If the MOC decides the data needs to be retransmitted from the ground station then the request needs to be received within 4 days.		Derived
Instrument Health and Safety				
GIOC6100	The GIOC shall monitor GBM health and status to verify proper operation of the instrument.	This is using recorded GBM HK data.	MSS	3.5.2.2 3.5.2.2.1
GIOC6110	The GIOC shall maintain an operations log which records operations activities.	This includes all changes to flight and ground system configurations whether directly commanded or initiated autonomously.		Derived
GIOC6120	The GIOC shall perform trend analysis of GBM housekeeping data over the life of the mission.	This is to assist operations personnel in predicting future performance and identifying potential performance issues		Derived
GIOC6130	The GIOC shall archive all Level 0 housekeeping data received, and all trend analyses, operations logs, calibration updates, and GBM diagnostic data developed.			Derived

Req ID	Requirement	Comments	Source	Source ID
GIOC6140	The GIOC shall use pre-launch test and calibration data to aid in assessing the performance of the instrument and adjust the instrument tables, engineering calibrations, or software.			Derived
GIOC6150	The GIOC shall maintain knowledge of the GBM configuration as determined from the telemetry, command history and operations logs.			Derived
Automation				
GIOC7000	The GIOC shall support autonomous data transfers from the MOC.	This ensures that the GIOC is designed to interact with an unstaffed MOC.	MSS	3.5.1.3
Alerts				
GIOC8000	The GIOC shall provide the MOC with a system to reformat LAT and GBM burst alert data and forward to the GCN.	This is referred to as the GBM burst alert processor (BAP), which will be located in the MOC facility.	MSS	3.5.2.8 3.5.3.3
GIOC8010	The GIOC shall provide the MOC a system to generate improved burst locations from GBM burst alert data and forward the results to the GCN.	This is referred to as the GBM burst alert processor (BAP), which will be located in the MOC facility.	MSS	3.5.2.8 3.5.3.3
GIOC8020	The GIOC shall provide a backup capability for the burst alert system provided to the MOC.	This is intended to require a backup BAP capabilities at the GIOC.	MSS	3.5.2.8 3.5.3.3
GIOC8030	The BAP and GIOC shall receive LAT and GBM burst telemetry from the MOC.	The BAP will generate GCN notices from the incoming burst alerts.	MSS	3.5.2.8 3.5.3.3
GIOC8040	The GIOC shall validate and refine the burst alert information using improved algorithms and additional GBM data and forward results to the GCN.		MSS	3.5.2.8 3.5.3.3

Req ID	Requirement	Comments	Source	Source ID
GIOC8050	The GIOC shall provide the GCN with any improved burst locations.		MSS	3.5.2.8 3.5.3.3

3.9 GSSC Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
GSSC0010	The GSSC shall perform science planning and generate a science timeline.		MSS	3.5.2.3
GSSC0020	The GSSC shall provide the science data analysis tools to support the science community.		MSS	3.5.1.5
GSSC0030	The GSSC shall adhere to mission specified data formats and standards.	The standards and formats for transferring data within the ground system will be documented in the Science Data Products ICD.		Derived
GSSC0040	The GSSC shall support an on-orbit operational lifetime of a minimum of 5 years following an initial period of on–orbit checkout.		MSS	3.5..1.8
GSSC0050	The GSSC shall organize and administer the GLAST GI Program.		MSS	3.5.2.3
GSSC0060	The GSSC shall receive and archive reports and analyses from the MOC.	These are the products that the GSSC and MOC have determined are relevant to science data analysis.		Derived
GSSC0070	The GSSC shall provide all data products to the HEASARC.		MSS	3.5.3.4
Reliability & Availability				
GSSC1000	The GSSC shall be maintained for the entire mission lifetime with no loss in GSSC capability or performance.			Derived

Req ID	Requirement	Comments	Source	Source ID
GSSC1010	The GSSC shall maintain the integrity of LAT and GBM commands and flight software loads received from the IOCs.	This is intended to ensure that the GSSC does not corrupt or make any other changes to the data.		Derived
GSSC1020	The GSSC shall maintain the integrity of science data received from the IOCs.	This is intended to ensure that the GSSC does not corrupt or make any other changes to the data.	MSS	3.1.2.6
Interfaces				
GSSC1500	The GSSC shall distribute data and software products to the scientific community		MSS	3.5.3.5
GSSC1510	The GSSC shall provide access to the science community to the Level 1 data within 24 hours of receipt at the GSSC.	Applies only if no problems are encountered that require operator intervention. Otherwise the data will be delivered on a best effort basis.	MSS	3.5.3.5
GSSC1520	The GSSC shall provide Level 2 data on the GSSC website and upon request.		MSS	3.5.3.5
GSSC1530	The GSSC shall provide the HEASARC all databases by the end of the GLAST mission.		MSS	3.5.2.10 3.5..2.11
GSSC1540	The GSSC shall deliver the as-flown timeline to the HEASARC.		MSS	3.5.3.4
GSSC1550	The GSSC shall interface with the MOC for the exchange of mission planning and data products.	Mission planning and data products include for example instrument flight software loads and ToOs. The specifics will be defined in the Operations Data Products Document.		Derived
GSSC1560	The GSSC shall interface with the LIOC for the exchange of mission planning and data products.	Mission planning and data products include for example instrument flight software loads and ToOs.		Derived

Req ID	Requirement	Comments	Source	Source ID
GSSC1570	The GSSC shall interface with the GIOC for the exchange of mission planning and data products.	Mission planning and data products include for example instrument flight software loads and ToOs.		Derived
GSSC1580	The GSSC shall provide the MOC the science timelines to incorporate into the Integrated Observatory Timeline.	These timelines are sequences of onboard activities.		Derived
GSSC1590	The GSSC shall receive the Integrated Observatory Timeline from the MOC.			Derived
GSSC1600	The GSSC shall receive the orbit data products from the MOC.	Orbit data products include definitive and/or predictive products.		Derived
GSSC1610	The GSSC shall receive the as-flown timeline from the MOC.			Derived
Data Processing				
GSSC2000	The GSSC shall maintain an archive of level 0, level 1 and level 2 products it receives.			Derived
GSSC2010	The GSSC shall provide the capability to receive and archive Level 0 data for the life of the mission.	The GSSC does not have to worry about overlaps among Level 0 files.		Derived
GSSC2020	The GSSC shall be responsible for producing and maintaining databases of the data products either received or produced.			Derived
GSSC2030	The GSSC shall conform all databases to the standards of the HEASARC.			Derived
GSSC2040	The GSSC shall handle overlapping Level 0 data delivered from the MOC when generating Level 1 data products.	This is needed for the backup pipeline processing.		Derived
G SSC2050	The GSSC shall maintain a backup Level 1 pipeline for processing LAT science data.			Derived

Req ID	Requirement	Comments	Source	Source ID
GSSC2060	The GSSC shall maintain a backup Level 1 pipeline for processing GBM science data.			Derived
GSSC2070	The GSSC shall calculate and maintain sky exposure maps.	This will provide the science team a record of the uniformity of sky coverage by LAT.	MSS	3.5.2.6
Integration & Test				
GSSC3000	The GSSC shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6
Mission Planning				
GSSC4000	The GSSC shall plan science observations and support science observation decisions.		MSS	3.5.2.3
GSSC4010	The GSSC shall construct observation timelines after guest investigations have been selected.		MSS	3.5.2.3
GSSC4020	The GSSC shall account for operational constraints when generating the observation timelines.	Examples include avoiding instrument activities during an SAA and not allowing the Earth to enter the LAT central field of view. The constraints will be documented in the Operations Description Manual or a comparable operations document.		Derived
GSSC4030	The GSSC shall maintain a record of all instrument loads and commands sent to the MOC.			Derived
Target Of Opportunity (ToO)				
GSSC4100	The GSSC shall receive ToO requests from the science community.		MSS	3.5.2.7.1
GSSC4110	The GSSC shall evaluate a ToO request.		MSS	3.5.2.7.1

Req ID	Requirement	Comments	Source	Source ID
GSSC4120	The GSSC shall generate and send to the MOC a ToO order within 2 hours of Project Scientist approval of the ToO request.		MSS	3.5.2.7.2
GSSC4130	The GSSC shall receive from the MOC information that specifies the status of the ToO order.		MSS	3.5.2.7.1
GSSC4140	The GSSC shall maintain a log for the duration of the mission of all ToO requests and orders their dispositions and status.		MSS	3.5.2.7.1
GSSC4150	The GSSC shall receive ToO execution notification from the MOC.		MSS	3.5.2.7.1
GSSC4160	The GSSC shall provide notification to the ToO requester of the ToO execution results.		MSS	3.5.2.7.1
Automation				
GSSC7000	The GSSC shall support autonomous data transfers to and from the MOC.		MSS	3.5.1.3
GSSC7010	The GSSC shall support an automated MOC.	This ensures that the GSSC is designed to interact with the MOC while it is unstaffed.	MSS	3.5.1.3
Alerts				
GSSC8000	The GSSC shall receive GLAST-produced GCN notices and post them to the GSSC web-site.			Derived
Offline Analysis				
GSSC9000	The GSSC shall confirm execution of the science plan and account for any differences between the scheduled science plan and the completed science activities.	i.e., the GSSC will use the as-flown timeline to determine the impact of ToOs and Autonomous Re-points to the original science plan.	MSS	3.5.2.2 & 3.5.2.2.1 derived

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3.10 GCN Requirements

Req ID	Requirement	Comments	Source	Source ID
Interfaces				
GCN1500	The GCN shall receive burst locations from the Burst Alert Processor (BAP).	These are locations from burst telemetry or calculations by the BAP that are sent automatically.	MSS	3.5.3.3
GCN1510	The GCN shall receive burst locationsalerts from the GIOC.	These are locations calculated from burst telemetry or recorded science data. This involves "human-in-the-loop" processing.	MSS	3.5.3.3
GCN1520	The GCN shall receive burst locations from the LIOC.	These are locations calculated from recorded science data. This involves "human-in-the-loop" processing.	MSS	3.5.3.3
GCN1530	The GCN shall distribute the burst GCN Notices to the science community.		MSS	3.5.2.8
Data Processing				
GCN2000	The GCN shall perform any GCN unique reformatting of the data received from the BAP, or GIOC, or LIOC.		MSS	3.5.3.3
Integration & Test				
GCN3000	The GCN shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6
Automation				
GCN7000	The GCN shall autonomously receive data from the BAP, GIOC or LIOC.			Derived

3.11 HEASARC Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
HEA0010	The HEASARC shall provide and maintain the archive and software infrastructure necessary for the analysis of GLAST data and the integration of this data into the HEASARC's multi-mission system.		MSS	3.5.2.10 3.5.2.11
HEA0020	The HEASARC shall integrate the GLAST specific tools developed into the general HEAdas system.			Derived
Interfaces				
HEA1500	The HEASARC shall provide and maintain servers for the GSSC to maintain its databases and website.			Derived
HEA1510	The HEASARC shall accept and archive data products from the GSSC.	Data products include science data products, reports, etc.	MSS	3.5.3.4Derived
HEA1520	The HEASARC shall make the GLAST observatory science and housekeeping data available over the Internet.		MSS	3.5.3.5
Integration & Test				
HEA3000	The HEASARC shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6

3.12 Spacecraft I&T Facility Requirements

Req ID	Requirement	Comments	Source	Source ID
Interfaces				
SAI1500	The Spacecraft I&T Facility shall interface with the CTV for RF compatibility interface testing.			Derived
SAI1510	The Spacecraft I&T Facility shall interface with the MOC for testing observatory/MOC telemetry and command compatibility.			Derived
SAI1520	The Spacecraft I&T Facility shall provide the MOC with a validated Observatory T&C Data Base.			Derived
Data Processing				
SAI2000	The Spacecraft I&T Facility shall archive observatory telemetry and command data during selected observatory I&T and space/ground interface tests.	The specifics as to when the data shall be archived will be determined during the testing phase.		Derived
Integration & Test				
SAI3000	The Spacecraft I&T Facility shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6
SAI3010	The Spacecraft I&T Facility shall provide observatory data to the MOC for test support.	This allows the MOC to be able to receive real-time and stored data from the Spacecraft I&T Facility pre-launch.		Derived
SAI3020	The Spacecraft I&T Facility shall allow the MOC to send commands to the observatory.			Derived

Req ID	Requirement	Comments	Source	Source ID
SAI3030	The Spacecraft I&T Facility shall have the capability to take over all commanding functions and restore the observatory to a safe configuration at any point in any MOC controlled test.			Derived
SAI3040	The Spacecraft I&T Facility shall have the ability to monitor observatory real-time operations during interface tests with the ground.	This ensures that the spacecraft contactor can independently (from the MOC) monitor observatory telemetry during ground interface tests.		Derived
Mission Planning				
Flight Software Maintenance				
SAI4000	The Spacecraft I&T Facility shall maintain the spacecraft flight software and provide the appropriate FSW updates to the MOC.			Derived

3.13 KSC Requirements

Req ID	Requirement	Comments	Source	Source ID
General				
KSC0010	The KSC shall provide access to voice circuits to the MOC during pre-launch and launch operations.			Derived
Security				
KSC0500	The KSC shall ensure that only authorized users can access the system.			Derived
Interfaces				
KSC1500	The KSC shall interface to the MOC for the exchange of observatory telemetry and command data.			Derived
Data Processing				
KSC2000	The KSC shall provide recorded observatory data (science and housekeeping) to the MOC.			Derived
Integration & Test				
KSC3000	The KSC shall provide the personnel and facilities to support pre-launch interface and system test activities.	This includes planning, performing and assessing the tests.	MSS	3.5.1.6
Mission Planning				
KSC4000	The KSC shall ensure MOC participation in pre-launch countdown simulations (Dry and Wet rehearsals).			Derived
Real-time Operations				
KSC5000	The KSC shall provide GLAST data to the MOC during pre-launch activities involving the observatory.			Derived

Req ID	Requirement	Comments	Source	Source ID
KSC5010	The KSC shall forward real-time observatory housekeeping data to the MOC in real-time without buffering, filtering, reformatting, processing, or staging.			Derived
KSC5020	The KSC shall receive command data from the MOC and forward to the observatory without buffering, filtering, reformatting, processing, or staging.			Derived
Offline Analysis				
KSC6000	The KSC shall provide post-separation vectors to the FDF.			Derived